

A66 Northern Trans-Pennine Project

TR010062

2.7 Environmental Management Plan Annex B1 Outline Landscape and Ecological Management Plan (Rev 2) (Clean)

APFP Regulations 5(2)(a)

Planning Act 2008

**Infrastructure Planning (Applications: Prescribed Forms and
Procedure) Regulations 2009**

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed
Forms and Procedure)
Regulations 2009**

A66 Northern Trans-Pennine Project
Development Consent Order 202x

**2.7 ENVIRONMENTAL MANAGEMENT PLAN
ANNEX B1 OUTLINE LANDSCAPE AND ECOLOGICAL
MANAGEMENT PLAN**

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B1 Outline Landscape and Ecological Management Plan

B1.1 Introduction and background to the Project

Purpose of the Landscape and Ecological Management Plan

B1.1.1 This document is the first iteration of the Landscape and Ecological Management Plan (LEMP) and provides a framework for achieving the design objectives and mitigation measures outlined in the Environmental Mitigation Plans (Application Document 2.8) for the dualling of the A66 Northern Trans-Pennine Project (the Project).

B1.1.2 The LEMP identifies what the landscape and ecology mitigation measures are; how they will be implemented, monitored, maintained and managed; and who will be responsible for ensuring they achieve their stated functions.

Objectives

B1.1.3 The objectives of the LEMP are as follows.

- To promote the conservation, protection and improvement of the physical, natural and historic environment within the Project and its immediate setting.
- To add ecological value through the retention, so far as reasonably practicable, of existing hedgerows, trees and other habitats of nature conservation value; and to enhance these through restoration and creation of diverse habitats offering greater botanical and faunal interest to the Project.
- To create new structural planting, linking existing habitats and promoting wildlife corridors.
- To use native indigenous species of local provenance.
- To provide landscape amenity enhancement through the introduction and appropriate management of vegetation and open space areas.
- To provide a variety of foraging, nesting and roosting opportunities for protected and notable species, including bats, badgers, invertebrates, amphibians, reptiles and birds.
- To create floristically rich habitats, to support a greater assemblage of species and give rise to enhanced foraging opportunities
- To provide a framework for monitoring and reviewing the landscape implementation and establishment.

The LEMP as an evolving document

B1.1.4 As stated in *Design Manual for Roads and Bridges (DMRB) LA 120 (DMRB LA 120) Environmental management plans* (Highways England, 2020)¹, subsequent to this first iteration of the LEMP, at least two further refined LEMP documents will be developed. Subsequent refinements are required in advance of the construction stage and at the end of the construction stage. The Principal Contractors (PCs) will ensure

¹ Highways England (2020) Design Manual for Roads and Bridges LA 120 Environmental management plans

subsequent refinements of this LEMP incorporate the detailed requirements set out in National Highways *DMRB Manual of Contracts for Highways Works (MCHW) Volume 1 Series 3000 Landscape and Ecology Series* (Highways England, 2001)² and accompanying appendices. The PC will demonstrate how the Project detailed design achieves the environmental functions stated in this iteration of the LEMP.

B1.2 Project team roles and responsibilities

B1.2.1 Roles and responsibilities for implementation of this LEMP are provided in Table 1: LEMP Team Roles and Responsibilities. Refer also to Section 2: Roles and Responsibilities of the Environmental Management Plan (EMP) (Application Document Number 2.7).

Table 1: LEMP Team Roles and Responsibilities

Position	Responsibility
National Highways' Project Manager	The National Highways Project Manager will instigate regular audits to report on compliance with the contract specification, environmental best practice and site-specific method statements. This will include the review of the monitoring, recording and reporting procedures being maintained by the Principal Contractor (PC) throughout the Project.
Principal Contractor's Project Manager	Project Manager appointed by the PC who would be responsible for overseeing the production of subsequent iterations of the LEMP prepared by the Environmental Manager, ensuring all controls within the LEMP and associated management plans are implemented by employees and sub-contractors. Responsible for the delivery of the Project and the environmental performance of the Project and all staff.
Principal Contractor's Environmental Manager	Full-time environmental manager to be appointed by the PC who would be responsible for developing subsequent iterations of the LEMP and implementing the LEMP from commencement of construction to end of construction. The environmental manager would oversee two key clerks of works roles.
Principal Contractor Biodiversity Consultant	Consultant appointed by the PC to carry out the landscape and ecological design, environmental consultancy, and inspection work. The Biodiversity Consultant will be responsible for ensuring commitments to Biodiversity Net Gain metrics are met. This will include re-running the BNG metric calculator at agreed intervals during detailed design and construction, amending mitigation areas where necessary to achieve the BNG output required by the Project.
Landscape Architect (LA)	The LA would be appointed by the PC and be responsible for ensuring the landscape design proposals are implemented, monitored and maintained in accordance with the requirements of the Project contract including subsequent iterations of the LEMP. This will include involvement with landscape earthworks, vegetation protection, clearance, soil stripping/storage, landscape earthworks, soft landscape proposals (woodland, trees, hedgerows, seeding) including liaison with the

² Highways England (2001) Manual of Contracts for Highways Works Volume 1 Series 3000 Landscape and Ecology Series

Position	Responsibility
	landscape contractor and advising on suitability of stock at nursery and upon delivery to the site.
Project Ecologist (PE)	The PE will be appointed by the PC and be responsible for ensuring ecological mitigation measures are implemented, monitored and maintained in accordance with the requirements of the Project design and LEMP. This will include nesting bird checks, movement of protected species to appropriate mitigation areas, overseeing of vegetation clearance and topsoil stripping, approval of mitigation structures. The PE will ensure that suitably experienced ecologists are contracted to undertake monitoring for protected species. The PE will ensure method statements within protected species licencing are followed.
Site Manager	To provide information on programme and timing of works, and issue to the Environmental advisor.
National Highways appointed Ecologist	This role will be appointed by National Highways after Year 5 and the Ecologist will be responsible for ensuring ecological mitigation measures are managed and monitored in accordance with the requirements of the LEMP and associated mitigation and management plans to be prepared during detailed design. The Ecologist will be responsible for ensuring suitably experienced ecologists are contracted to undertake monitoring for protected species and habitat condition after Year 5 and suitable contractors are appointed to carry out ongoing management requirements.

Working Group

- B1.2.2 The contractor shall ensure continuous engagement on landscape and ecology with relevant stakeholders during the construction of the Project.
- B1.2.3 A working group will meet at regular intervals from the commencement of the construction stage through to the end of construction to provide independent advice on the development of the landscape and ecological detailed design, construction, and management of the Project.
- B1.2.4 Consultation by the Working Group should be undertaken with key stakeholders including, and not limited to, county and local authorities, district authorities, Natural England, National Trust, Wildlife Trust, North Pennines AONB, plus a range of other landscape, heritage wildlife and ecological stakeholders and representatives of affected landowners. A finalised list of all relevant stakeholders to be consulted with should be in developed and detailed in further iterations of the LEMP.
- B1.2.5 The Working Group's roles would be:
- To discuss on any alternative proposals to the Environmental Mitigation Plan (Application Document 2.8) and the alignment of the proposals with the vision and objectives of the Environmental Mitigation Plan (Application Document 2.8).
 - To work with National Highways to develop the methods for survey and monitoring of the establishment of the landscaping and ecological habitat creation.

- To liaise with National Highways to identify any requirements or actions needed to achieve the successful establishment of the landscaping and ecological habitat creation.
- To identify and explore opportunities to link the mitigation of the project to existing initiatives such as Local Nature Recovery Networks.

B1.3 Programme

- B1.3.1 Details of the Project program are set out in section 1.2 the EMP (Application Document Number 2.7).
- B1.3.2 Establishment maintenance and monitoring operations of all landscape and ecology works are to be carried out by the PC as part of their works up to end of construction.
- B1.3.3 The PC's aftercare maintenance period starts immediately following end of construction. The PC shall carry out maintenance and monitoring of the landscape and ecological works for a period of five years.
- B1.3.4 All landscape and ecological works shall be carried out by suitably qualified and experienced professionals in landscape and ecological construction activities. Experts will be appointed for specialist activities in horticulture, arboriculture and/or ecology during construction and for maintenance and management activities. All landscape and ecology operations shall be carried out according to the Project contract requirements.
- B1.3.5 After the five-year maintenance and monitoring period by the contractor, National Highways will have the responsibility for the continued management and monitoring of the ecological mitigation areas. Any areas required to achieve the No Net Loss / Biodiversity Net Gain commitments of the proposed scheme will be managed for up to a 30-year period to ensure the appropriate habitat type and condition is achieved.

B1.4 Consents and permissions

- B1.4.1 This section outlines the consents, commitments and permissions sought after and resulting from liaison with statutory bodies. This is to be undertaken by the PC in relation to landscape and ecology aspects of the Project.
- B1.4.2 The principal consent for the Project is the Development Consent Order, this enables land acquisition and temporary possession, along with other associated consents and powers. There can be a requirement for additional consents and permissions to supplement the DCO. These are outlined in section 4 of the EMP: Consents and Permissions (Application Document Number 2.7).
- B1.4.3 The PC will update this section in subsequent iterations of the LEMP to cover developments through the Project detailed design stage and throughout the construction phase, to ensure all relevant consents and permissions are captured.

B1.5 Landscape and ecological context of the Project

Introduction

- B1.5.1 The PC shall satisfy themselves as to the location and extent of the following sensitive landscape, ecology, arboricultural features and designations ensuring that the necessary protection measures and full permits are gathered before commencement of any works.

Landscape

- B1.5.2 This section identifies national and local landscape designations that coincide with the Project working area. These are presented on ES Figure 10.4: Zone of Theoretical Visibility (ZTV 3km) and Viewpoints (Application Document 3.3).

UNESCO global geoparks

- B1.5.3 The North Pennines AONB Global Geopark coincides with the study area and covers the same area as the North Pennines AONB described below. Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development.

Areas of outstanding natural beauty

- B1.5.4 The North Pennines Area of Outstanding Natural Beauty coincides with the Project study area. The Countryside and Rights of Way Act 2000 identifies that areas are designated as AONB for the purpose of "*Conserving and enhancing the natural beauty of the area.*"

Registered parks and gardens

- B1.5.5 Registered Parks and Gardens (RPG) are a non-statutory cultural heritage designation. They are considered in the Landscape and Visual Impact Assessment (LVIA) in the context of their contribution to landscape character and, where relevant, their importance as a visitor destination and implications for visual amenity and views. Rokeby Park RPG lies within the Cross Lanes to Rokeby Scheme working area.

Local landscape designations

- B1.5.6 Local authorities may identify landscapes with scenic qualities or characteristics that they consider should be afforded policy protection in local development plans. Durham County Council has identified Areas of High Landscape Value (AHLV). Bowes Bypass Project and Cross Lanes to Rokeby Project are in Dales Fringe AHLV.

Ecology

- B1.5.7 This section identifies national and local ecology designations that coincide with the Project study area. These are shown in ES Figure 6.1: Statutory and Non-statutory Designated Sites (Application Document 3.3).

Special Areas of Conservation (SAC)

- B1.5.8 Four SACs (River Eden, North Pennine Moors, Helbeck and Swindale Woods and Moor House-Upper Teesdale) are located within 2km of the Project.
- B1.5.9 The River Eden SAC is designated for the following qualifying habitats (annex 1 priority habitats are shown with an asterisk*):
- Clear water lakes or lochs with aquatic vegetation and poor to moderate nutrient levels: Oligotrophic to mesotrophic standing waters with vegetation of the *Littorelletea uniflorae* and/or of the *Isoëto-Nanojuncetea*.
 - Rivers with floating vegetation often dominated by water crowfoot: Watercourses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation.
 - Alder woodland on floodplains: Alluvial forests with alder (*Alnus glutinosa*) and ash (*Fraxinus excelsior*) (*Alno-Padion*, *Alnion incanae*, *Salicion albae*)*.
- B1.5.10 Annex II species that are the River Eden's primary reason for designation are:
- Otter (*Lutra lutra*)
 - Sea lamprey (*Petromyzon marinus*)
 - Brook lamprey (*Lampetra planeri*)
 - River lamprey (*Lampetra fluviatilis*)
 - Atlantic salmon (*Salmo salar*)
 - Bullhead (*Cottus gobio*)
 - White-clawed (or Atlantic stream) crayfish (*Austropotamobius pallipes*).
- B1.5.11 The North Pennine Moors SAC primary features for designated are the following annex I habitats:
- Annex I habitats that are a primary reason for selection of this site:
 - European dry heaths
 - Juniper (*Juniperus communis*) formations on heaths or calcareous grasslands
 - Blanket bogs (* if active bog) *Priority feature
 - Petrifying springs with tufa formation (*Cratoneurion*) *Priority feature
 - Siliceous rocky slopes with chasmophytic vegetation
 - Old sessile oak woods with *Ilex* and *Blechnum* in the British Isles.
- B1.5.12 Helbeck and Swindale Woods SAC is designated due to the presence of *Tilio-Acerion* forests of slopes, screes and ravines annex I habitat.
- B1.5.13 Moor House-Upper Teesdale SAC primary features for designated are the following annex I habitats:
- Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp.
 - Alpine and Boreal heaths
 - Juniper (*Juniperus communis*) formations on heaths or calcareous grasslands

- Calaminarian grasslands of the *Violetalia calaminariae*
- Siliceous alpine and boreal grasslands
- Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites)
- Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*)
- Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels
- Mountain hay meadows
- Blanket bogs
- Petrifying springs with tufa formation (*Cratoneurion*) *Priority feature
- Alkaline fens
- Alpine pioneer formations of the *Caricion bicoloris-atrofuscae** Priority feature
- Siliceous scree of the montane to snow levels (*Androsacetalia alpinae and Galeopsietalia ladani*)
- Calcareous and calcshist screes of the montane to alpine levels (*Thlaspietea rotundifolii*)
- Calcareous rocky slopes with chasmophytic vegetation
- Siliceous rocky slopes with chasmophytic vegetation.

Special Protection Areas (SPA)

- B1.5.14 North Pennine Moors SPA is situated 255m from the Project (Bowes Bypass), its qualifying features are the bird species present (Golden Plover (*Pluvialis apricaria*), Hen Harrier (*Circus cyaneus*), Merlin (*Falco columbarius*), Peregrine (*Falco peregrinus*), Curlew (*Numenius arquata*) and Dunlin (*Calidris alpina schinzii*).

Sites of Special Scientific Interest (SSSI)

- B1.5.15 There are 12 SSSIs designated for biodiversity within 2km of the Project. The SSSIs include the River Eden and Tributaries, Black Scar Quarry, Brignall Banks, Kilmond Scar, Bowes Moor, Swindale Wood, Helbeck Wood, Appleby Fells, George Gill, Temple Sowerby Moss, Udford Low Moss and Cowraik Quarry.

Local Nature Reserves (LNR)

- B1.5.16 There is one LNR situated within the study area, Cowraik Quarry, designated for presence of habitats of principal importance, deciduous woodland (oak-birch woodland) and heathland, the presence of red squirrel (*Sciurus vulgaris*) and many bird species including redstarts (*Phoenicurus phoenicurus*), crossbill (*Loxia curvirostra*), tree-creeper (*Certha familiaris*), great spotted woodpecker (*Dendrocopos major*) and green woodpecker (*Picus viridis*). In addition the following invertebrate species are noted green tiger beetle (*Cincidela campestris*), slender mining bee (*Lasioglossum calceatum*), field digger wasp (*Mellinus arvensis*), eyed ladybird (*Anatis ocellata*) and hoverfly species (*Chriorhina floccosa* and *C. ascilica*).

County Wildlife Sites (CWS)

B1.5.17 There are 23 non-statutory designated sites within the study area. These are county level designations and cover a range of habitat types including woodland, grassland and heathland.

Sites of Invertebrate Significance

B1.5.18 There are ten sites of invertebrate significance within the River Eden SAC/River Eden and tributaries SSSI and Temple Sowerby SSSI.

Ancient Woodlands

B1.5.19 There are 16 ancient woodlands within 1km of the Project: Skirsgill Wood, Yanwath Wood, Tipperary and Dudford Woods, Salter Wood, Dowpits Wood, Kiln Hill Wood, Yosgill Wood, Mill Wood, Thorsgill Wood, Tees Bank Plantation, Waterfall Wood, Oglebird Plantation, Chapel Wood, Ross Wood, Graham's Gill/Jack Wood and Hartforth Wood.

Priority Habitats

B1.5.20 There are 127ha of Section 41 Habitat of Principal Importance within 250m of the Project. These include coastal and floodplain grazing marsh, deciduous woodland, lowland fen, purple moor grass and rush pasture, traditional orchard and upland heathland.

Protected Species

B1.5.21 The following protected species were identified within the study area:

- Bats (roosting and flight lines)
- Red squirrel
- Otter
- Badger (*meles meles*)
- Reptiles
- Breeding and wintering birds
- Barn owl
- Amphibians.

B1.5.22 The presence of protected species will need to be taken into account when carrying out maintenance and management activities. The appropriate timing of works which affect habitats to avoid breeding or hibernating seasons should be monitored and adapted throughout operation to reflect changes in the timing of animal behaviour as a result of climate change. Suitable mitigation measures for protected species affected by temporary works are set out in the EMP (Application Document 2.7).

Arboriculture

B1.5.23 There are a number of Tree Preservation Orders (TPOs) across the Project (Application Document 5.24) as well as veteran trees. TPOs will need to be updated and reviewed by the PC at each iteration of the LEMP through confirmation with relevant local authority's database. It may be necessary to instruct Arboricultural Impact Assessments providing details of tree groups, species and root protection areas.

B1.6 Environmental function and landscape elements

B1.6.1 The landscape mitigation proposals are listed in the Environmental Mitigation Schedule (Application Document 2.9) and illustrated on the Environmental Mitigation Plans (Application Document 2.8). Refer to section 3: Register of Environmental Actions and Commitments of the EMP (Application Document 2.7) outlining further, non-landscape, ecological and environmental actions and commitments.

Environmental function codes

B1.6.2 The landscape and ecology mitigation elements within the Project design have been assigned environmental function codes in accordance with Table 4.2a in *DMRB LD 117 Landscape Design* (Highways England, 2020)³. This table has been reproduced below as Table 2: Environmental function codes.

Table 2: Environmental function codes

Code	Principal function
EFA	Visual screening
EFB	Landscape Integration
EFC	Enhancing the built environment
EFD	Nature conservation and biodiversity
EFE	Visual amenity
EFF	Heritage
EFG	Auditory amenity
EFH	Water quality

B1.6.3 Function codes clarify the purpose of the Project landscape and ecology elements and assist in identifying priorities for maintenance and management decision-making. Where more than one code has been used, management shall seek to achieve each function equally.

Landscape elements

B1.6.4 The landscape and ecology mitigation elements within the Project design have been assigned landscape element (LE) codes in accordance with Table 4.2b in *DMRB LD 117*. LEs are used in the Environmental Mitigation Maps (Application Document 2.8). The LEs will be implemented, monitored, maintained and managed to achieve the environmental function(s) as defined in Table 2: Environmental function codes. Table 3: Project LEs below states the LEs included within the Project.

Table 3: Project LEs

³ Highways England (2020) Design Manual for Roads and Bridges LD 117 Landscape design

Code	Description
LE 1.3	Species Rich (or Conservation) Grassland
LE 1.5	Heath and Moorland
LE 1.6	Open Grassland
LE 2.1	Woodland
LE 2.2	Woodland Edge
LE 2.8	Scrub
LE 3.1	Amenity Tree and Shrub Planting
LE 4.3	Native Species Hedgerows
LE 4.4	Native Hedgerows with Trees
LE 5.1	Individual Trees
LE 6.1	Water Bodies and Associated Plants
LE 6.4	Marsh and Wet Grassland
LE 7	Hard Landscape Elements

- B1.6.5 Where there is a commitment to create a specific habitat type for nature conservation to meet Biodiversity Net Gain (BNG) / No Net Loss targets, these habitat types are listed below within the most relevant LE and the indicative locations of habitat types and target conditions are shown in Appendix D: Figures - Figure 1: Post-construction Habitats and Figure 2: Target Habitat Condition.
- B1.6.6 The habitat types and conditions referred to in this report and associated figures are based on definitions in the *Biodiversity Metric 2.0 Technical Supplement* (Crosher *et al.*, 2019)⁴. Target condition is based on habitats meeting a series of criteria specific to the type of habitat (for instance woodland, heathland, grassland), with habitats passing most or all criteria rating as good condition, those passing few or none rating as poor condition, and those passing some rated as moderate condition.
- B1.6.7 All Project seed and plant material required for any LE will be of local provenance as per Forestry Commission Information Note FCIN082 (Forestry Commission, 2006)⁵. For further information on provenance and biosecurity refer to Appendix A: Technical Advice Note - A.1: Provenance and Biosecurity.
- B1.6.8 The proposed species mixes, where specified, aim to take into account resilience of vegetation to ensure mitigation remains effective throughout operation in light of changes to temperatures and precipitation due to climate change.

Any replacement planting to account for failures during longer term

⁴ Crosher, I., Susannah, B., Heaver, M., Heydon, M., Lauren, D., Scott, S., Stone, D., White, N. and Panks, S. (2019) The Biodiversity Metric 2.0: Auditing and accounting for biodiversity value: technical supplement (Beta version, July 2019)

⁵ Forestry Commission (2006) Choosing Provenance in Broadleaved Trees

management will also need to take account of the effects of climate change.

B1.7 Species rich grassland - LE 1.3

B1.7.1 Species rich grassland will function as landscape integration (EFB) and/or nature conservation and biodiversity (EFD). Species-rich grassland will be the default treatment for all the unplanted soft landscape areas such as verges, cuttings, and embankments included in the Project (labelled as EFB on the Environment Mitigation Plans (Application Document 3.3). If seeding is required within any central reservations LE 1.3 will be used. The different species-rich grassland functions will be under different maintenance regimes, as stated below.

Seeding and establishment - LE 1.3

B1.7.2 Establishment of species rich grassland will be critical to the visual appearance of the Project given its ubiquity.

B1.7.3 Where species-rich grassland is to be established as ecology mitigation (EFD) the Project Ecologist shall specify a soil treatment (e.g. nutrient strip, turf and topsoil strip, harrow/scarify) and seed mix or seed mixes to create the target UK Hab habitat type taking account of site conditions. The UK Hab habitat types under this LE currently include:

- Other neutral grassland
- Floodplain wetland mosaic
- Other lowland acid grassland
- Other tall herb communities
- Upland acid grassland
- Open mosaic habitat on previously developed land.

B1.7.4 To guide detailed design of soil treatments or seed mixes for the UK Hab types, soil sampling, along with the chemical component, will include DNA assessment of the soils to identify existing fungal and higher plant diversity to confirm existing ecological potential. This information will be used to ensure no net loss of plant species or inappropriate planting and allow the consideration of natural regeneration, where warranted, due to an existing seed bank which may re-establish under a different management regime.

B1.7.5 Prior to vegetation removal the PC will identify areas of species-rich grassland that are likely to contain a seed bank of nature conservation value that could be re-used on the project. The careful excavation, storage and re-use of soils for nature conservation purposes will be detailed in later iterations of the EMP (Application Document 2.7) and LEMP. The Project Ecologist shall also identify areas of species-rich grassland that lie adjacent to proposed expanses of species-rich grassland providing an opportunity to encourage natively occurring fauna and flora to colonise new habitats. The Project Ecologist will advise where such areas are suitable to be used as green hay or where natural colonisation can be considered in place of planting or seeding.

- B1.7.6 The PC is encouraged to take a pro-active approach to demonstrate their understanding of this LE e.g. through the use of advance seeding / test plots that promote best practice in ground preparation and wildflower seeding establishment.
- B1.7.7 Grassland seed mixes used for the A66 pollinator project 'Get Cumbria Buzzing' have been designed to support insects local to the area and use locally relevant plant species. Subsequent iterations of the LEMP will include Project Ecologist recommendations for seed mixes for the general species-rich grassland areas following consultation with the Get Cumbria Buzzing working group.
- B1.7.8 It should be noted that open mosaic habitat on previously developed land is not a grassland type but has been included on the environmental masterplans under LE 1.3 due to a lack of suitable alternatives. This UK Hab will need a specific habitat creation plan which is unlikely to include grassland seeding due to the requirement for bare ground. Natural regeneration is likely to be the preferred method of habitat creation with plug planting of native wildflowers suitable for pollinators only required if there are no donor sites adjacent to the proposed location. There may also be a requirement to bring aggregates on to the site to create mounds and bare ground features.

Monitoring, Maintenance and Management - LE 1.3

- B1.7.9 The objectives for the monitoring and management of LE 1.3 are to achieve its EFB and/or EFD functions and comply with GG 103 Introduction and general requirements for sustainable development and design, Introduction and general requirements for sustainable development (Highways England, 2019)⁶.
- B1.7.10 A single species-rich seed mix will not be universally and successfully established across the Project due to varied conditions across the Project such a soil and hydrology, hence the importance of maintenance, monitoring, adaptive management and remedial measures. A detailed management plan for each UK Hab type and each ecology mitigation area within the Project will need to be developed for subsequent iterations of the LEMP.
- B1.7.11 Initial cutting of the grassland to occur in April and October, in order to maintain a vegetation height of 100–150 mm, and not below 50 mm, until the grassland has become established. Upon establishment, reduce cutting to once a year preferably in late summer/early autumn, to a height of 50 mm after the plants have flowered. Depending on soil type and quality, more frequent cutting may be required during establishment phase. LE 1.3 within central reservations shall not be subject to any establishment cuts and shall be cut once every five years or as needed in line with the *Manual of Contract Documents for Highways Works (MCHW)* (Department for Transport, 2022)⁷.

⁶ Highways England (2019) Design Manual for Roads and Bridges GG103 Introduction and general requirements for sustainable development and design

⁷ Department for Transport (2022) Manual of Contract Document for Highway Works

- B1.7.12** Arisings to be collected and removed off site at each cut to prevent nutrients returning to the soil and the build-up of coarse grasses and succession to woodland.
Where required to promote additional germination, arisings can be left for 1-7 days to allow seed to fall before being collected.
- B1.7.13** Grazing, cutting, or a mix of both prevent change to a species-poor sward dominated by coarse grasses and succession to woodland.
- B1.7.14** Where grazing is the selected management method within ecology mitigation areas (EFD), it will be controlled or prevented for the first three years to allow the grassland to become established and seedlings to develop sufficient root systems to prevent uprooting when grazed. Upon establishment, grazing can commence. Exact stocking requirements are specific to the site objectives. In winter and during prolonged wet conditions, livestock will be removed to prevent poaching – the compaction or physical breakdown of soil structure under the feet of heavy animals. The grazing timings and approximate stock densities for species-rich grasslands recommended by the Wildlife Trusts (Norfolk Wildlife Trust, 2022)⁸ (Kent Wildlife Trust, 2018)⁹ is shown in Table 4: Recommended grazing timings and approximate stocking densities based on guidance by the Wildlife Trusts.

Table 4: Recommended grazing timings and approximate stocking densities based on guidance by the Wildlife Trusts

Time of year	Grazing regime	Stock density in Livestock Units (LU) (where dairy / beef cattle or horse = 1LU; 6-month to 2-year heifer = 0.6LU; lowland sheep or goats = 0.15LU; upland sheep or goats = 0.1LU; pony = 0.6LU).
January to February	Remove grazing	N/A
March	Light grazing only (none if ground nesting bird mitigation area)	0.4-0.6LU/Ha for drier grasslands 0.3LU/Ha for acid grassland or wet grassland
April to July	Very light or no grazing (none if ground nesting bird mitigation area)	0.4-0.6LU/Ha for drier grasslands 0.3LU/Ha for acid grassland or wet grassland
July to end December	Main grazing period, with light grazing over a long period to help create a varied sward height allowing some “islands”, corners, margins or tussocks to over-winter.	1LU/Ha or 0.4-0.6LU/Ha for neutral and drier grassland depending on conditions. 0.3LU/Ha for acid grassland or wet grassland

- B1.7.15** Overly intensive management can be damaging. All-year-round grazing or mowing too often can inhibit flowering, reducing species richness of

⁸ Norfolk Wildlife Trust (2022) Managing wildflower grasslands in Norfolk

⁹ Kent Wildlife Trust (2018) A brief guide to choosing livestock for conservation grazing

the sward. Ploughing and application of herbicides or inorganic fertilisers will be restricted.

- B1.7.16 The general non-targeted use of herbicides will be avoided, unless for safety reasons there is no other option, limiting application to spot treatment when this is prescribed for the problem species.
- B1.7.17 Applications of herbicide to noxious weeds within grassland to be a maximum frequency of one application per problem species per year to avoid over reliance on herbicide and potential regrowth after spraying stops such as may happen when maintenance responsibilities are handed over at the end of year five.
- B1.7.18 Problem species within grasslands shall not be treated until underlying causes are tackled otherwise the problem can persist even with treatment.
- B1.7.19 The Ecologist and Landscape Architect shall jointly monitor development of LE 1.3 and identify remedial actions to be undertaken by the PC in years 0-5.
- B1.7.20 Beyond year 5 the National Highways appointed Ecologist shall be responsible for monitoring LE 1.3 areas required for ecology mitigation (EFD) and recommending any remedial actions required to be undertaken by National Highways. Habitat management commitments within ecology mitigation areas (EFD) for the Project are expected to extend up to 30 years after completion. The remaining areas of species-rich grassland (EFB) would be managed as part of standard highways verge management in line with the *MCHW* to ensure they are maintainable under this standard.
- B1.7.21 Monitoring of grassland or open mosaic habitat condition in ecology mitigation (EFD) areas will be undertaken in years 3, 5 and 10 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the Project Ecologist.

B1.8 Heathland and Moorland - LE 1.5

- B1.8.1 A relatively small area of heathland and moorland habitat is proposed on the Appleby to Brough scheme, Ch. 40100. This habitat has a dual function of landscape integration (EFB) and nature conservation and biodiversity (EFD).

Seeding and establishment - LE1.5

- B1.8.2 The Project Ecologist shall specify the methods and objectives of establishment, taking into account site conditions and the requirement of a reptile receptor site in this area. The establishment of site conditions shall follow that set out in paragraph B.1.7.4. The methods for establishment on heathland should follow advice provided in 'A practical guide to the restoration and management of lowland heathland' Symes

and Day (2003)¹⁰. These can include plug planting or seed harvesting from a nearby donor site (see advice note on Harvesting and using heather seed by Flora locale (2019¹¹)). Ground will need to be cleared of existing vegetation prior to seeding or planting and soil treatment may be required depending on site conditions.

Monitoring, maintenance and management - LE1.5

- B1.8.3 The objectives of management will be to create and retain a mosaic of vegetation types and structural diversity and achieve the UK Hab Upland Heathland in good condition. Due to the location of the proposed heathland on the Appleby to Brough scheme the preferred method of grazing is unlikely to be practical therefore a detailed management plan using mechanical intervention will need to be prepared by the Project Ecologist.
- B1.8.4 Habitat management commitments for the Project are expected to extend to at least 10 years after completion.
- B1.8.5 Monitoring of heathland habitat condition in mitigation areas will be undertaken in years 3, 5 and 10 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the Ecologist.

B1.9 Open Grassland - LE 1.6

- B1.9.1 All agricultural land that is to be returned to agriculture will be seeded with an appropriate open grassland mix (LE 1.6) if required by the landowner.
- B1.9.2 Agricultural soil profiles are typically 300-400mm of topsoil on ripped subsoil. Suitable ground preparation methods and seeding mixes will be developed with the owners. There are no further management or maintenance requirements as the lands will be returned to the owner.

B1.10 Woodland - LE 2.1

- B1.10.1 Woodland planting will achieve a dual function of landscape integration (EFB) and nature conservation and biodiversity (EFD).
- B1.10.2 Where the function is landscape integration the objective for all woodland blocks is to mimic the structure and value of locally occurring native broadleaved woodlands such as those that characterise the banks of the River Eden.
- B1.10.3 For all woodland planting areas the Project Ecologist will refer to the Botanical Society of the British Isles (BSBI) heatmaps (which will be available on DEFRA Magic website from June 2022) to ensure tree planting does not affect known botanical hotspots for other habitat types.

¹⁰ Symes, N. and Day, J. (2003) A practical guide to the restoration and management of lowland heathland, The RSPB, Sandy

¹¹ Flora locale (2019) Harvesting and using heather seed.p65

Planting and establishment - LE 2.1

B1.10.4 Planting for landscape integration (EFB) will be at an average density of 1.5 metre centres (1 plant every two square metres) to provide reasonably quick establishment without incurring excessive costs.

B1.10.5 The dominant canopy will consist of English Oak and Sessile Oak. Sub dominant trees associated with oak in native seed zone 302 include aspen, field maple, rowan and lime. Birch and alder will be included to function as a nurse crop.

Table 5: Broadleaved Woodland Species

Species	Common Name	Specification	Height
<i>Quercus robur</i>	English Oak	BR Transplant	60-80cm
<i>Quercus petraea</i>	Sessile Oak	BR Transplant	60-80cm
<i>Populus tremula</i>	Aspen	BR Transplant	60-80cm
<i>Betula pendula</i>	Silver Birch	BR Transplant	60-80cm
<i>Betula pubescens</i>	Downy Birch	BR Transplant	60-80cm
<i>Alnus glutinosa</i>	Common Alder	BR Transplant	60-80cm
<i>Malus sylvestris</i>	Crab Apple	BR Transplant	60-80cm
<i>Sorbus aucuparia</i>	Rowan	BR Transplant	60-80cm
<i>Sorbus torminalis</i>	Service Tree	BR Transplant	60-80cm
<i>Sorbus aria</i>	Whitebeam	BR Transplant	60-80cm
<i>Tilia cordata</i>	Small leaved lime	BR Transplant	60-80cm
<i>Ulmus glabra</i>	Wych elm	BR Transplant	60-80cm

B1.10.6 Where local conditions are seasonally or permanently wet, suitable planting mixes will be developed including some or all of the following species that are native to provenance zone 302.

Table 6: Wet Woodland Species

Species	Common Name	Specification	Height
<i>Quercus robur</i>	English Oak	BR Transplant	60-80cm
<i>Quercus petraea</i>	Sessile Oak	BR Transplant	60-80cm
<i>Populus nigra var. betulifolia</i>	Black Poplar	BR Transplant	60-80cm
<i>Betula pubescens</i>	Downy Birch	Seedling	60-80cm
<i>Salix aurita</i>	Eared Willow	BR Transplant	60-80cm
<i>Salix cinerea</i>	Common Sallow	BR Transplant	60-80cm
<i>Alnus glutinosa</i>	Common Alder	BR Transplant	60-80cm
<i>Sorbus aucuparia</i>	Rowan	BR Transplant	60-80cm
<i>Sorbus aria</i>	Whitebeam	BR Transplant	60-80cm

B1.10.7 The broadleaved mix in Table 6: Wet Woodland Species is suitable to create the UK Hab 'Other broadleaved woodland' and the species mix in Table 5 is suitable for the UK Hab 'Wet woodland'. The other UK Hab

woodland types required will need specific species mixes developed with the Project Ecologist depending on site conditions. These include Lowland mixed deciduous woodland; Other Scot's pine woodland and Other woodland mixed - to include conifer species for red squirrel (see paragraph B1.21.28).

The translocation of existing trees and shrubs should be considered by the Project Ecologist where practicable to bring forward the establishment of mature woodland.

- B1.10.8 The establishment of woodland in ecology mitigation areas will require a bespoke planting design for each plot taking into account site conditions and adjacent woodland types. The design will follow the Woodland Trust's guidance (Woodland Trust, 2022)¹² on woodland management as well as considering natural regeneration, where an adjacent woodland with suitable species mix is present. The aim of the woodland planting designs will be to create structurally diverse woodlands which include groves, open wooded habitat and glades as well as additional features such as ponds, ditches and banks.

Monitoring, Maintenance and Management - LE 2.1

- B1.10.9 The objectives for the monitoring and management of LE 2.1 are to achieve its EFB and EFD functions and comply with *GG 103 Introduction and general requirements for sustainable development*.
- B1.10.10 Woodland areas will be managed in landscape integration areas (EFB) to promote rapid establishment of plants with the aim of canopy closure by year five at the latest. The key principles of maintenance and management are to ensure planting performs its stated environmental functions. Landscape integration will be achieved if the planted areas have started to blend the Project in to the receiving landscape by years 3-5. The provision of structurally diverse woodland habitat will contribute to habitat linkages/wildlife corridors.
- B1.10.11 Depending on the final planting layout, seeding may be required prior to planting to prevent the influx of weeds such as thistles and ragwort within the open space between trees. A minimum of a one metre wide band or one metre diameter spot is required weed free around each tree from April to July for at least four years after planting. The large-scale use of herbicide shall be discouraged to minimise danger to operators, other plants and wildlife. Herbicide shall be applied a maximum of three times per year with actual quantities applied decreasing as canopy closure increases.
- B1.10.12 In periods of drought weed control will be all the more important to ensure that trees are free from competition for moisture. The PC will inspect all planting following extreme weather events.
- B1.10.13 Young trees will be vulnerable to damage from wind, pests, diseases and drought. If left unweeded they can stay vulnerable for many more years and the risk of failure becomes substantial. During years 0-5 weeds will be removed from tubes and shelters by hand pulling.

¹² Woodland Trust (2022) Woodland Creation Guide

Weeds and coarse grasses within one metre of any plant will be controlled. The PC will ensure that coarse grasses within open spaces near to plants are cut at minimal frequency with arisings collected and removed off site.

- B1.10.14 Watering will be required in sufficient quantities to ensure planting achieves its stated environmental function.
- B1.10.15 During years 0-5 the LA will undertake monitoring of LE 2.1 including inspections and commentary on:
- Stock prior to planting (both at the nursery and on site)
 - Ground preparation and soil horizon
 - Setting out
 - Planting methods
 - Plant protection
 - Establishment progress
 - Plant failures.
- B1.10.16 The PC will give notice to National Highways before commencing any of the operations to be monitored.
- B1.10.17 The Landscape Architect will provide monthly reports setting out key issues and proposed remedial measures. The PC will carry out remedial measures within the timeframes specified in the Project Managers Instructions.
- B1.10.18 The principles of adaptive and dynamic management shall apply to minimise the risk of catastrophic failures such as may occur in periods of drought or other unforeseeable events such as the identification of a new biosecurity / plant health hazard.
- B1.10.19 Any plants that fail to thrive will be replaced in the first available planting season following identification and the replacements will be in the ground such that they can be inspected in the month of January as this will allow enough time for additional stock to be purchased and planted if advised by the LA.
- B1.10.20 The PC shall ensure failed plants are replaced with stock that is equivalent to a healthy plant that has survived in a similar location.
- B1.10.21 Low management intervention is envisaged beyond year 5 as planted stock shall be considered to have settled into the receiving environment if species have taken. Any failures will have been replaced before year 5.
- B1.10.22 The Project Ecologist will monitor yearly removal of undesirable species. Where trees are to be removed or growth restricted such as to create glades for terrestrial invertebrates, removal should be done in November each year. The National Highways appointed Ecologist will advise at years 5-10 where thinning should occur once the most successful species in different parts of the site have been identified and to promote these with management.

- B1.10.23 Removal of tree guards will be staged across years 3 to 5 - see A2: Tubes, Guards and Ties in Appendix A: Technical Advice Notes for further information on plant protection.
- B1.10.24 Regarding the production, transportation, implementation and maintenance of plant material and ancillary products, the PC will demonstrate that the principles of GG103 have been incorporated into the Project detailed design.
- B1.10.25 Habitat management commitments for the Project for woodland areas (both newly planted and existing) required for ecology mitigation (EFD) are expected to extend to 30 years after completion. Each woodland area will require a bespoke management plan depending on the whether management by intermittent grazing or mechanical cutting is agreed with landowners. Natural regeneration and natural processes will be encouraged where possible to promote a range of ecosystem services. All deadwood from management or natural occurrences will remain in the woodland.
- B1.10.26 Monitoring of woodland habitat condition in mitigation areas will be undertaken in years 5, 10, 20 and 30 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the National Highways appointed Ecologist. Adaptive management will also need to take in account monitoring results for protected and priority species where woodland planting is also mitigation for these species, including red squirrel, amphibians and reptiles (open rides/glades), bats, barn owl and terrestrial invertebrates (deadwood).

B1.11 Woodland Edge LE2.2

- B1.11.1 Woodland edge planting functions as landscape integration (EFB) and nature conservation and biodiversity (EFD). At the Warcop junction (Appleby to Brough, Ch. 44350 to 44500, westbound) the woodland edge planting has a visual screening function (EFA).
- B1.11.2 Woodland edge planting is located on the periphery of woodland areas (LE 2.1) or in isolation where dominant medium to large sized canopy trees could be unsafe due to proximity to the highway.
- Planting - LE 2.2*
- B1.11.3 Where shown on the Environmental Mitigation Plans suitable woodland edge mixes will be developed including some or all of the following small tree and shrub species that are native to provenance zone 302.
- B1.11.4 The translocation of existing trees and shrubs should be considered by the Project Ecologist where practicable to bring forward the establishment of mature woodland edge.

Table 7: Woodland Edge Species

Species	Common Name	Specification	Height
<i>Crataegus monogyna</i>	Common Hawthorn	BR Transplant	40-60cm

Species	Common Name	Specification	Height
<i>Sorbus aucuparia</i>	Rowan	BR Transplant	40-60cm
<i>Ilex aquifolium</i>	Common Holly	Containerised	40-60cm
<i>Viburnum opulus</i>	Guelder-rose	BR Transplant	40-60cm
<i>Salix cinerea</i>	Grey willow	Cutting/transplant	40-60cm
<i>Prunus spinosa</i>	Blackthorn	BR Transplant	40-60cm
<i>Rosa canina</i>	Dog Rose	BR Transplant	40-60cm
<i>Acer campestre</i>	Field Maple	BR Transplant	40-60cm
<i>Corylus avellana</i>	Common Hazel	BR Transplant	40-60cm

Monitoring, Maintenance and Management - LE 2.2

B1.11.5 Monitoring, maintenance and management for Woodland Edge (LE 2.2) requirements including weed control and watering to be as stated above for Woodland (LE 2.1) and as refined in subsequent iterations of the LEMP. The objectives for the monitoring and management of LE 2.2 are to achieve its EFB, EFD and EFA functions.

B1.12 Scrub Planting - LE 2.8

B1.12.1 Scrub planting (LE 2.8) will fulfil the function of nature conservation and biodiversity (EFD).

Planting and establishment - LE 2.8

B1.12.2 Scrub planting is proposed in the locations shown on the Environmental Mitigation Plans. Species and establishment requirements will be developed by the Project Ecologist.

B1.12.3 The translocation of existing shrubs should be considered by the Project Ecologist where practicable to bring forward the establishment of mature scrub.

Monitoring, Maintenance and Management - LE 2.8

B1.12.4 Monitoring, maintenance and management requirements for Scrub Planting (LE 2.8) including weed control and watering to be as stated above for Woodland (LE 2.1) and as refined by the Project Ecologist in subsequent iterations of the LEMP.

B1.12.5 Habitat management commitments for the Project are expected to extend to 30 years after completion.

B1.12.6 Monitoring of scrub habitat condition in mitigation areas will be undertaken in years 5, 10, 15 and 20 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the Ecologist. Adaptive management will also need to take in to account monitoring results for protected and priority species where scrub planting is also mitigation for these species, including red squirrel, bats, barn owl and terrestrial invertebrates (deadwood).

B1.13 Amenity tree and shrub planting - LE 3.1

- B1.13.1 Amenity tree and shrub planting (LE 3.1) is proposed as enhancement or compensation for Wetheriggs Country Park, to the east of the current County Park. This planting will function as landscape integration (EFB) and nature conservation and biodiversity (EFD).
- B1.13.2 Species selection, establishment, monitoring, maintenance and management requirements for Amenity tree and shrub planting (LE 3.1) to be as stated above for Woodland (LE 2.1) and as refined by the PC in subsequent iterations of the LEMP. The objectives for the monitoring and management of LE 3.1 are to achieve its stated environmental function(s).
- B1.13.3 Further details will be agreed in consultation with the Local Authority.

B1.14 Native species hedgerows - LE 4.3

- B1.14.1 Approximately half of the hedgerows proposed in the Project will be LE 4.3 Native species hedgerows. This element will perform a dual function of landscape integration (EFB) and nature conservation and biodiversity (EFD).

Planting and establishment - LE 4.3

- B1.14.2 Where shown on the Environmental Mitigation Plans suitable native species hedgerows will be planted including some or all of the following hedgerow species that are native to provenance zone 302. Hedges will be planted in double staggered rows at a rate of 5 plants per linear metre.
- B1.14.3 The translocation of existing hedgerows should be considered by the Project Ecologist where practicable to bring forward the establishment of mature hedgerows.

Table 8: Hedgerow Species

Species	Common Name	Specification	Height
<i>Crataegus monogyna</i>	Common Hawthorn	BR Transplant	60-80cm
<i>Ilex aquifolium</i>	Common Holly	Containerised	60-80cm
<i>Viburnum opulus</i>	Guelder-rose	BR Transplant	60-80cm
<i>Salix cinerea</i>	Grey willow	Cutting/transplant	60-80cm
<i>Prunus spinosa</i>	Blackthorn	BR Transplant	60-80cm
<i>Rosa canina</i>	Dog Rose	BR Transplant	60-80cm
<i>Acer campestre</i>	Field Maple	BR Transplant	60-80cm
<i>Corylus avellana</i>	Common Hazel	BR Transplant	60-80cm

Monitoring, Maintenance and Management - LE 4.3

- B1.14.4 The objectives for the monitoring and management LE 4.3 are to achieve its EFB and EFD functions. Monitoring, maintenance and management

for LE 4.3 to be as stated above for LE 2.1 and as refined in subsequent iterations of the LEMP.

- B1.14.5 The PC will ensure that weeds, grass and other materials do not restrict growth of any hedgerow.
- B1.14.6 During years 0-5 the PC will remove weeds from tubes and shelters by hand pulling. The PC will control weed and coarse grass growth within one metre of any plant. Hedges will be trimmed around year three to five to promote bushy growth, particularly at base of hedgerow to reduce available light for weeds and grasses.
- B1.14.7 Beyond year five all hedgerows will be cut annually to prevent them becoming unmanageable or untidy. Hedges will be managed on a three-year rotation with one side cut a year to help develop the desired tall bushy structure. Certain hedges (as indicated on the Environmental Mitigation Plans (Application Document 2.8)) are to be left as tall as possible (minimum 2-3m) where they serve as a barn owl or bat crossing point.
- B1.14.8 If managed by laying, this should be on a rotational basis from year 10 onwards. This is a traditional management technique and seeks to retain the structural integrity of hedgerows and maintain connections with other habitats. Cutting will be carried out at the end of the winter in February, thereby retaining berries through the winter months for wildlife, and avoiding the bird breeding season.
- B1.14.9 The PC will cut back undergrowth, overgrowing or overhanging shrubs and minor tree branches from adjacent pathways, walls or fences to allow unobstructed, safe access and maintenance to take place.
- B1.14.10 Additional monitoring, maintenance and management requirements including weed control and watering will be as stated above for LE 5.1.
- B1.14.11 Habitat management commitments for the Project are expected to extend to 30 years after completion.
- B1.14.12 Monitoring of hedgerow habitat condition in mitigation areas will be undertaken in years 5, 10 and 20 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the Ecologist. Adaptive management will also need to take in account monitoring results for protected and priority species where hedgerow planting is also mitigation for these species for connectivity, including red squirrel and bats/barn owl.

B1.15 Native hedgerows with trees - LE 4.4

- B1.15.1 Approximately half of the Project native hedgerows will include hedgerow trees along their length. Native hedgerows with trees (LE 4.4) will function as landscape integration (EFB) and nature conservation and biodiversity (EFD).

Planting and establishment - LE 4.4

- B1.15.2 Hedgerow planting requirements are set out in 1.14 above. Hedgerow trees will be planted at a rate of 1 per 25 metres with random intervals. Hedgerow tree species will include oak, rowan and whitebeam.

Monitoring, Maintenance and Management - LE 4.4

- B1.15.3 Monitoring, maintenance and management for LE 4.4 to be as stated above for LE 4.3 and as refined by the Ecologist in subsequent iterations of the LEMP. The objectives for the monitoring and management LE 4.4 are to achieve its EFB and EFD functions.

B1.16 Individual Trees - LE 5.1

- B1.16.1 Individual Trees (LE 5.1) are proposed as a precautionary replacement measure in the locations shown on the Environmental Mitigation Plans. Should existing mature specimen trees be lost at these locations during construction, a like for like replacement in terms of species and size will be required as far as reasonably practical. The function of this planting will be landscape integration (EFB).

- B1.16.2 The individual trees at Rokeby will subject to agreement with CH officer.

Planting and establishment - LE 5.1

- B1.16.3 Individual Trees will be planted in accordance with *BS 8545: 2014 Trees: from nursery to independence in the landscape – Recommendations (BS 8545)* (British Standards, 2014)¹³.

- B1.16.4 The translocation of existing trees should be considered by the Project Ecologist where practicable to bring forward the establishment of mature trees.

Monitoring, Maintenance and Management - LE 5.1

- B1.16.5 Monitoring, maintenance and management for Individual Trees (LE 5.1) to be as stated above for Woodland (LE 2.1) and as refined in subsequent iterations of the LEMP. The objectives for the monitoring and management LE 5.1 are to achieve its EFB and EFD function

B1.17 Waterbodies - LE 6.1

- B1.17.1 The primary purpose of the drainage ponds is control of surface water run-off from the scheme, to avoid increasing flood risk and to maintain or improve the quality of water infiltrating groundwater.

- B1.17.2 Waterbodies required for ecological mitigation will be planted with an appropriate mix of native aquatic and marginal plants and defined as LE 6.1 or left to vegetate naturally if they are close to an existing established waterbody. The function of this planting is nature conservation and biodiversity (EFD). The Project Ecologist will review whether additional pond creation can be incorporated into mitigation areas in order to maximise opportunities for enhancement.

¹³ British Standards (2014) BS 8545: 2014 Trees: from nursery to independence in the landscape – Recommendations

Establishment

- B1.17.3 Newly created waterbodies have been included where they would be of benefit to amphibians or where they are needed to replace ponds directly lost to the Project to achieve No Net Loss of habitats. These ponds will be located where surface run-off or drains from agricultural areas and roads are minimal. Pond edges will be shallow (<10cm for at least 1m (5degree slope)) to allow a rich community of marginal plants to develop, providing food and shelter for developing tadpoles. Ponds will be planted with suitable assembles of submerged and emergent vegetation or left to vegetate naturally if they are close to an existing established waterbody.
- B1.17.4 An additional purpose is to provide benefits for ground-nesting birds such as lapwing and golden plover, creating ephemeral wet areas within grassland habitats. The specification for these will be captured in a detailed habitat creation and management plan for bird mitigation areas in a subsequent iteration of the LEMP.

Monitoring, maintenance and management

- B1.17.5 Pond management prescriptions will be detailed in subsequent iterations of the LEMP when ponds have been designed and planting detailed up.
- B1.17.6 Habitat management commitments for the Project are expected to extend to 30 years after completion.
- B1.17.7 Monitoring of pond habitat condition in mitigation areas will be undertaken in years 3, 5, 10 and 20 using UK Hab survey and BNG condition assessment. If the expected UK Hab type and condition are not as required to achieve No Net Loss, the management regime will be adapted in consultation with the Ecologist. Adaptive management will also need to take into account the presence of protected species such as great crested newts before management activities are undertaken.

B1.18 Marsh and Wet Grassland - LE 6.4

- B1.18.1 All swales and ditches required for engineering purposes will be seeded with an appropriate wet grassland mix, the function of this grassland is landscape integration (EFB).
- B1.18.2 Seeding, monitoring, maintenance and management of LE 6.4 to be as stated above for LE 1.3 with the additional requirement that all swales and ditches will be kept free of any materials that impede their drainage function. The objectives for the monitoring and management LE 6.4 are to achieve its EFB function.
- B1.18.3 There is a specific requirement to create fen habitat for the Appleby to Brough project as bespoke mitigation. The approach to this will need to be agreed with the Project Ecologist once hydrology factors and site conditions are known. The details of fen habitat creation will need to be agreed with Natural England.

B1.19 Drystone walls LE 7.1

- B1.19.1 Proposed drystone walls fall under the hard landscape features element code (LE 7.1) and the primary function will be landscape integration (EFB).
- B1.19.2 Within Temple Sowerby to Appleby the following functions will also be achieved:
- Near Kirkby Thore Primary School on Cross Street there is a function to enhance the built environment (EFC)
 - The walls at the top of the false cutting embankment slopes (Ch. 30500 to 32150) have a heritage (EFF) and partial retaining function that aims to replicate lynchets; and a visual amenity (EFE) function that will compliment views of the North Pennines
 - The wall between the A66 and detrunked A66 near Spitals (Ch. 30950 and 22950) helps to reduce headlight glare.
- B1.19.3 Wall design is covered in more detail in the Project Design Principles (Application Document 5.11).
- B1.19.4 Future iterations of the LEMP will provide details on the height and width of the walls as well as the coping/caping and the PC will demonstrate how their detailed design relates to their environmental function.
- B1.19.5 Maintenance and monitoring of the walls for non-environmental reasons will be undertaken by an engineer. The Landscape Architect will provide advice on planting design in proximity to both existing and proposed walls to ensure the landscape-related function(s) will be fulfilled.

B1.20 Biodiversity strategy

- B1.20.1 The measures identified for implementation by the PC are based on the outcomes of the assessments reported in ES Chapter 6: Biodiversity (Application Document Number 3.2) and reflect the preliminary design of the Project illustrated on ES Figure 2.1: Order Limits (Application Document 3.3).
- B1.20.2 The proposed biodiversity mitigation and enhancement measures are summarised below. These proposals have been designed to be delivered within the Order Limits, as well as to retain, where possible, the existing planting within the Order Limits. Habitat creation and landscaping have been accommodated, alongside the protection and enhancement of existing habitats where feasible.
- B1.20.3 The key measures within the Project design are as follows.
- To achieve No Net Loss for biodiversity while maximising opportunities for enhancement, measured by BNG metrics.
 - To maintain and enhance wildlife connectivity, both east-west and north-south, to enable dispersal between local populations and future migration of species in response to climate change.
 - Long term management of new and retained habitats within the Order Limits to ensure establishment of habitats in line with UK Hab definitions and achieve commitments.

- Inclusion or adaptation of structures within the Project design, or provision of planting, which allow a range of mammals and other species to move safely across the new dual carriageway.
- Installation of a number of habitat features, such as bird and bat boxes, across the Project to enhance opportunities for species to roost and breed.
- Enhancement of habitats for invertebrate species by increasing structural diversity and variety of habitat niches within created and retained habitats, such as the provision of deadwood.

B1.20.4 The measures include protection for habitats and for protected or notable species, habitat creation and maintenance during the construction period and post-construction management. Indicative locations for all biodiversity features are shown on Environmental Mitigation Plans (Application Document 2.8). The undertaking of these works will be the responsibility of the PC during the construction and initial maintenance period of 5 years. Ongoing management required during the operational life of the Project after this period will lie with National Highways as the organisation responsible for the long-term maintenance of the asset. Essential mitigation required during construction is detailed in Chapter 6: Biodiversity (Application Document 3.2) and the EMP (Application Document 2.7).

B1.21 Fauna species mitigation

Bats

B1.21.1 The results of the bat surveys provided in ES Appendix 6.11: Bats (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in Chapter 6: Biodiversity (Application Document 3.2).

Green Bridges

B1.21.2 Greening of the proposed overbridges which occur near to bat crossing points will provide or maintain north-south connectivity for bats and other species and reduce the risk of collision mortality.

B1.21.3 The locations of the required greening of bridges include Cross Street overbridge, Fell Lane overbridge, Sleastonhow Lane overbridge, Rogerhead Farm overbridge, Warcop overbridge, East Bowes accommodation access bridge, Cross Lanes junction overbridge and Collier Lane, West Layton.

B1.21.4 The green bridges will incorporate a minimum 1 m wide strip of trees/wooded scrub along one road verge, with connective planting to the north and south aspects of the bridge, providing a continuous green corridor across the new live carriageway.

B1.21.5 Inclusion of both light and noise deflection screens incorporated into the overbridge design will further enhance the mitigation effectiveness to provide a sheltered crossing point for bats (and other ground fauna) commuting within the landscape.

Planting and Fencing

B1.21.6 Planting of woodland habitats, including linear woodland and hedgerows, on both the northern and southern approach aspects to underbridge/culvert structures, will provide flight connectivity across the alignment and encourage bats to cross safely, reducing the risk of collision mortality.

Selected locations require barrier fencing extending away from the structure on both the north and south aspects to prevent bats flying across the new widened carriageway and encourage bats to use the underpass.

B1.21.7 Planting of trees on the verges either side of the new live carriageway and as close as possible to the carriageway edge in a departure from standards, will be required to raise commuting bats over the live carriageway to avoid/minimise road traffic collision mortality at specific locations. The final planting plan for each bat crossing point will need to be devised through detailed design in consultation with the Project Ecologist.

Replacement Bat Roost Provision

B1.21.8 Bat houses would be required at two locations, High Barn and Low Broats Farm, to compensate for the direct loss of an identified bat roost. The design of bat houses suitable to compensate for loss of existing roosts will be developed during the European Protected Species Licensing (EPSL) process. Appropriate landscape planting around the bat houses will need to be designed in consultation with the Project Ecologist.

B1.21.9 Bat boxes will be provided affixed to retained mature trees to provide suitable roost sites for a range of bat species as replacement of potential tree roosting opportunities. Existing mature trees noted with moderate or high bat roost potential within the baseline surveys will determine the equivalent number of replacement roosting opportunities through inclusion of one rocket style bat box (or equivalent) provided on a basis of 1 per 5 moderate or high potential trees to be lost. The bat boxes will be located along linear habitats or on woodland edge habitats. Final locations of bat boxes will be agreed with the Project Ecologist and detailed in the method statement for the EPSL application.

Badger

B1.21.10 The results of the badger surveys provided in ES Appendix 6.9: Badger (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in Chapter 6: Biodiversity in the ES (Application Document 3.2).

Artificial sett

B1.21.11 Where a main badger sett is to be closed and badgers excluded, an artificial sett is to be created in suitable habitat within the territory of the main sett. An excavator will be used to excavate the sett. Chambers and pipe runs will be buried at a depth of at least 1 metre except around the entrances. Trenches will be excavated for pipes and any additional gravel required to provide drainage.

- B1.21.12 The excavator will dig channels between some of the chambers and the sett entrances. Plastic pipes (of 300mm diameter) will be installed to connect some of the chambers and link to the sett entrances. The bottom of the pipes will be removed prior to installation so that badgers can walk on the soil. If not possible, large slits will need to be made in the bottom of the plastic pipes at frequent intervals to allow water to drain out of the pipes. Pipes will be placed on a bed of gravel to further encourage drainage of water out of the pipes. The connections between the pipes and the chambers will not be flush resulting in soil being exposed at the sides in some places to allow digging opportunities for badgers.
- B1.21.13 Once the chambers and the pipes are in situ, the sett will be covered in mesh to deter illegal interference. The excavator will then cover the mesh-covered sett in soil to a depth of 1 metre. Tree and shrubs (particularly scrub species of local provenance) will be planted by hand over the sett to provide cover.
- B1.21.14 Other woody material sourced from site clearance such as cut branches, rooted bramble and leaf litter, will be used to provide additional cover over the sett and to screen the sett entrances. Once the sett is complete, evidence of badger from active setts (e.g. bedding and latrines) will be moved and will be placed outside the artificial sett to encourage badger use. Any loose sub-soil at the front of the closed badger setts will also be moved across and placed outside the entrances to the artificial sett to produce a spoil heap. The moving of materials from the setts to the artificial sett will be done by hand (or using hand tools), to avoid any accidental damage.

Crossing points

- B1.21.15 Specialised crossing points will be created to allow safe passage of badger under the Project at specified locations which have good habitat connectivity with existing landscape features such as hedges and ditches. The tunnels will be constructed of Class M concrete pipes which will be widened at the entrances. The tunnel diameter will be a minimum of 600 mm as studies have shown that tunnels wider than 600 mm are regularly used by badger whereas tunnels of 300 mm and 450 mm were never or infrequently used¹⁴. The tunnel design will prevent the tunnel from becoming waterlogged and vegetation will be planted around the entrance to ensure good cover. Existing underpasses will also be retained and enhanced to ensure badgers are able to move across the project.

Badger Fencing

- B1.21.16 One proven method for deterring badgers from crossing a road is the use of badger fencing directing badgers to suitable crossing points. Badger fencing is required at either side of new crossing points (preferably to a distance of 500m each side) and on both sides of the road. The fencing must be used to guide badgers to the crossing by providing an angled

¹⁴ Use of badger tunnels by mammals on Highways Agency Projects in England. Bonnie Eldridge & Jules Wynn. Atkins Ltd., 3100 Century Way, Thorpe Park, Leeds, LS15 8ZB, UK

approach or recess leading to the crossing. The exact angle of approach is not critical, but where a recess is formed this should not be so deep and narrow that badger can pass it by without realising it is there.

B1.21.17 The most effective specification is for chain link or welded mesh fencing attached to wooden post and rail fences using heavy duty staples. As a minimum standard, this will be at least 1m high above ground with a lower section of 600mm buried below ground; 300mm down into the soil and a further 300mm turned away from the fence in the direction from which badgers will approach. Any gap or potential weak spot in the fencing may negate the entire fence. It is therefore of particular importance that where the fencing crosses difficult features - for example undulating ground or streams - it is installed under the supervision of a suitably experienced person. Gaps must be avoided where the fencing abuts other features such as hedges, footbridges, gates or stiles.

Otter

B1.21.18 The results of the otter surveys provided in ES Appendix 6.16: Otters (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).

Artificial holt

B1.21.19 Where an otter holt is to be heavily disturbed and otter likely to be discouraged from using it, an artificial holt is to be created. The artificial holt will be located as close to the existing holt and associated watercourse as possible, within the 8-metre zone, where there will be little human disturbance. The artificial holt will consist of one or two chambered structures built from breeze blocks or log piles with at least two entrances. An external pipe entrance will connect the holt to the river's edge at normal water level so that the animal can enter unobtrusively direct from the river. The entrance will slope down to reduce the chances of flooding. A second entrance will provide an exit onto the riverbank. Both entrances need to be well concealed.

B1.21.20 Once the holt is complete, evidence of otter from active holts (e.g. bedding and spraint) will be moved and will be placed outside the artificial holt to encourage use.

Ledges

B1.21.21 Where bridges or culverts are being built on watercourses on which otter are present, ledges will be installed to allow dry passage for otter that is accessible during floods. Ledges can be built of solid concrete, or with a bolt on design using metal brackets and wooden planks or mezzanine flooring sections. Ledges will be at least 500 mm wide and must be accessible from the bank of the watercourses by ramps. There must also be provision for the otter to gain access to the ledge from the water, either via the bank, or by use of a ramp sloping down to below the water level.

B1.21.22 The ledge will be sited at least 150 mm above the highest water level and allow for 600 mm headroom, allowing otters to pass through at all times. If an obstacle, such as a weir, is located under the bridge, then steps will

be provided to allow the otter to climb over the obstruction or onto the ledge.

Underpass

- B1.21.23 Where it is not possible to install a bridge or culvert with enough room for a ledge of the correct dimensions, an underpass will be constructed alongside, parallel to the river. The underpass should be located within 50 metres of the riverbank and above possible flood levels. The underpass entrance should be located near the road so the otter associates the underpass with the road crossing. Otters can be guided to the passage by means of a channel running from the riverbank to the entrance of the underpass or by fencing. The entrance to the crossing should be softened by the use of appropriate planting.
- B1.21.24 The underpass will be constructed using a 600 mm cylindrical pipe to a length of 20 m. In crossings over 20 m in length, the width of the pipe should increase to 900 mm, to ensure otters will not be deterred from entering. Underpasses should be kept as short as possible but do not need to be straight although this is preferable. The pipes should be laid to falls and the joints between pipes should be sealed to prevent water seepage as the underpass should not become waterlogged.

Fencing

- B1.21.25 Fencing should be used to guide otter to safe crossing points and prevent them from gaining access to the road. The installation of badger fencing is most effective option using 50 mm mesh. This type of fencing is essential if badgers or rabbits are present in the locality to prevent the fence being undermined. The addition of a mesh overhang at the top of 300 mm, angled away from the road is essential to prevent otter from climbing. Where the fence abuts bridge rails, gate posts or a different type of fence, there should be no gaps greater than 50 mm. The fence must be installed on both sides of the road for at least 100 m from the watercourse or underpass. This fencing can also be combined with deer fencing if an overhang is provided 1 m off the ground and mesh of 50 mm or less is used below this point. It is possible to reduce the height of the fence to a minimum of 0.75m but the overhang should be retained. Care should be taken that changes made to the fence for aesthetic reasons do not negate the efficacy of the design, making the fence redundant. The fence design must be approved by an otter expert instructed via the Project Ecologist so that it will remain effective.

Red Squirrels

- B1.21.26 The results of the red squirrel surveys provided in ES Appendix 6.10: Red Squirrels (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).

Crossing Points

- B1.21.27 Animex Wildlife bridges (or equivalent) are to be installed to connect red squirrel habitat severed by the Project. Two types of red squirrel crossings will be installed throughout the Project, standalone bridges which are independently supported by steel columns for installation in

locations where there is no existing structure, and retrofit bridges fixed to existing structures such as a culvert, underpass tunnel, or bridge overpass. In some cases, vegetation may need to be planted at the ends of the bridge for full connectivity.

B1.21.28 Once the red squirrel bridges are installed, it is important that the habitat at either end remains well-connected and suitable for red squirrel to thrive. Optimal red squirrel habitat is required at both ends of the bridge. The bridge will be suitably connected to surrounding vegetation, as well as arboreal habitat connectivity with the wider landscape. The landscape planting detail around each crossing point will need to be defined during detailed design in consultation with the Project Ecologist.

Planting

B1.21.29 Where planting is required to mitigate for lost woodland or as connection between habitats, tree species beneficial to red squirrels should be specified. These include but are not limited to (in order of preference): Scot's pine (*Pinus sylvestris*), Corsican pine (*Pinus nigra*), lodgepole pine (*Pinus contorta*), Douglas fir (*Pseudotsuga menziesii*), larch (all types) (*Larix* sp.), Norway spruce (*Picea abies*), hazel, cherry (*Prunus avium*), hornbeam (*Carpinus betulus*) and hawthorn. Ideally 50-60% of the forest should contain conifers of seed producing ages, therefore the planting of trees of differing ages would be beneficial to create better structural heterogeneity in the habitat and allow the food source to return sooner. The final woodland planting specification to achieve replacement red squirrel habitat and the appropriate UK Hab for BNG commitments will need to be devised in consultation with the Project Ecologist.

Birds (breeding and wintering)

B1.21.30 The results of the bird surveys provided in ES Appendix 6.13: Breeding Birds and ES Appendix 6.14: Wintering Birds (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2). Mitigation for breeding birds is outlined below for species other than for Barn Owl, which are addressed in the following sections.

Nest boxes

B1.21.31 The installation of nest boxes on retained trees or poles aims to aid in mitigating the loss of natural nesting habitats such as trees, hedgerows and scrub. It is recommended that between one and 40 nest boxes be installed per hectare in mitigation areas. The types of nest boxes could be included as follows:

- 60% with 32 mm entrance hole
- 20% with 26 / 25 mm entrance hole
- 20% to be boxes suitable for species which nest in recesses or cavities.

B1.21.32 The nest boxes will be made of durable materials (for example, woodcrete) to increase their longevity. Total numbers of boxes provided will relate to the approximate number of natural nesting opportunities lost during the Project development.

Final numbers and locations of nest boxes should be agreed with the Project Ecologist within the parameters specified above.

Planting

B1.21.33 Planting is required to mitigate for the loss of existing habitats. New native trees would be planted as part of the landscape design and existing hedgerows would be enhanced and new ones planted. Planting would include a mix of typical hedgerow species which provide berries and other foraging resources for birds, for example hawthorn, blackthorn and field maple.

Grassland for waders

B1.21.34 The breeding bird and winter bird surveys identified habitats within and adjacent to the site as being of value to waders, gulls and geese species and the mitigation designs include the provision of grassland attractive to waders, specifically golden plover and lapwing. The design of each bird mitigation area will require assessment of site conditions and will need to be undertaken in consultation with the Project Ecologist to take account of specific species needs. The grassland sward on these sites will need to be kept short and open and this should be considered when selecting a suitable grass and wildflower seed mix. Scrapes will be created within the grassland areas to increase the amount of invertebrate-rich feeding grounds. Management activities must be implemented outside of the main periods of usage by breeding and wintering birds (September to November).

B1.21.35 Woodland which abuts these areas and single trees within the area should be cleared to reduce avian and fox predation, where possible and under the advice of the Project Ecologist, taking account of other protected species and BNG/landscaping limitations.

Barn Owl

B1.21.36 The results of the barn owl surveys provided in ES Appendix 6.15: Barn Owls (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).

Barn Owl Boxes

B1.21.37 Approximately 78 Barn Owl nest boxes funded by the Project will be erected outside the Project extents by the Barn Owl Trust so there are no further actions by the PC with regard to Barn Owl boxes.

Planting

B1.21.38 Planting of woodland habitats, including linear woodland and hedgerows, on both the northern and southern approach aspects adjacent to suitable barn owl habitat, will provide flight connectivity across the alignment. Obstacle provision (planting of continuous hedges or lines of closely spaced trees) and a grass fly-way (Shawyer 2019)¹⁵ at key crossing points are expected to force barn owls to fly up and over the obstacles,

¹⁵ Shawyer, C. (2019) Barn Owl Mitigation and Major Infrastructure Schemes

above the height of oncoming traffic reducing the potential occurrence of Road Traffic Accidents (Ramsden 2007)¹⁶.

B1.21.39 The height of obstacle planting will be a minimum of 3 m high, but ideally 4-5m to help barn owls avoid Heavy Goods Vehicles (HGVs). The indicative location of obstacle planting is shown on the mitigation plans at the standard distance of woodland and scrub planting in accordance with DMRB guidelines.

B1.21.40 Planting will be as close as safely practicable to the carriageway (specifically where departures can be agreed with National Highways and implemented safely) and final planting plans will be confirmed during detailed design with the Project Ecologist for all barn owl crossing locations. Obstacle planting will be undertaken up to 4.5m away from the carriageway, however in some locations obstacle planting would be required closer to the carriageway in order to minimise the effect upon barn owls. In these locations departures need to be agreed with National Highways prior to agreement and implementation.

Reptiles

B1.21.41 The results of the reptile surveys provided in ES Appendix 6.7: Reptiles (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).

Reptile receptor sites

B1.21.42 Reptile receptor sites are included throughout the Project. These areas require advanced planting with a scrub/grassland mosaic or cessation of management/grazing to allow longer grass to develop. The following features will be included in each reptile receptor area with numbers of each structure to be informed by further reptile survey and detailed mitigation design. The following features can also be sited on other areas of the scheme as an enhancement measure as instructed by the Project Ecologist. These would be particularly beneficial near to proposed waterbodies.

Hibernacula

B1.21.43 These will be constructed of rubble or alternative material and covered by topsoil created from materials on site that are to be cleared. The *Reptile Habitat Management Handbook* (Edgar et al., 2010)¹⁷ provides the following design principles including the following.

- A sunny position.
- A well-drained site, not prone to flooding.
- Orientation so that one of the long banks faces south.
- Access for reptiles through openings of some sort.
- Location in a patch of habitat favourable for dispersal, such as tussocky grassland.

¹⁶ Ramsden, D. (2007) Barn Owls and Major Roads: results and recommendations from a 15-year research project

¹⁷ Edgar, P., Foster, J. and Baker, J. (2010) Reptile Habitat Management Handbook. Amphibian and Reptile Conservation, Bournemouth

- Minimal public disturbance.
- At least 4 metres long, by 2 metres wide by 1 metre high and ideally much larger.

Log piles

B1.21.44 Log piles (with potential to incorporate additional brash) will be installed to form sheltering sites for reptiles. A number of these features are to be multifunctional and designed to allow reptiles and other animals to overwinter within them and, additionally, will benefit deadwood invertebrates. Brash material can be added to log piles by adding additional material as the existing material decomposes. This can be provided from ongoing tree and scrub management activity. Both represent methods of utilising felled wood generated from any on-site tree felling.

Egg laying

B1.21.45 Egg laying sites will be formed of brash and/or grass and vegetation cuttings mounded up. The decay of any cuttings will create heat encouraging grass snake egg laying. The structure of these features should ensure entry points for reptiles are maintained.

Amphibians

- B1.21.46 The results of the amphibian surveys provided in ES Appendix 6.6: Amphibians (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).
- B1.21.47 Habitat loss will be mitigated for via the creation of terrestrial habitat and ponds across the Project. Ponds will be located where surface run-off or drains from agricultural areas and roads are minimal. Pond edges will be shallow (<10cm for at least 1m (5degree slope)) to allow a rich community of marginal plants to develop, providing food and shelter for developing tadpoles. Ponds will be planted with suitable assembles of submerged and emergent vegetation.
- B1.21.48 Great Crested Newts are being mitigated for under Natural England District Level Licencing (DLL). The DLL approach includes strategic area assessment, the identification of risk zones and strategic opportunity area maps, and a mechanism to ensure adequate compensation is provided. The outcome of this assessment is documented within the Impact Assessment Conservation Payment Certificate (ES Appendix 6.6: Amphibians (Application Document 3.4)) and identified that the impacts associated with the Project equated to 15.6 compensatory ponds (that will be created within strategic locations off site).
- B1.21.49 Dry underpasses and culverts created for otter and badger, particularly those over 20 m in length and therefore constructed to 900 mm diameter, will provide habitat connectivity for amphibians across the Project.
- B1.21.50 In addition, reptile mitigation sites detail above will be suitable for us by amphibians.

Fish/White Clawed Crayfish/Aquatic invertebrates and macrophytes

B1.21.51 The majority of watercourse crossings have been designed to reduce impacts on watercourse beds, banks and alteration of the natural flow regime, thus minimising disturbance and species mortality, via the designs of viaducts and open span bridges. In addition, a number of measures and potential opportunities to enhance aquatic habitats, improve water quality, and improve connectivity for fish and other aquatic species have been identified and will be developed further at detailed design stage and include the following. The Project Ecologist will develop these opportunities further in line with the Water Framework Directive enhancement proposals.

- Barriers to fish migration; Thacka Beck (M6 Junction 40 to Kemplay Bank) is disconnected from the River Eamont under low flow conditions as the watercourse is significantly perched at the confluence with the River Eamont, which restricts fish migration between the two rivers under low flows. Fish passage improvements could be made locally to address this.
- Degradation of riparian habitats as a result of poaching (sheep) of the banks was recorded along Light Water and Unnamed Tributary of River Eamont 3.3 (Penrith to Temple Sowerby). Improvements in riparian and instream habitat, as well as water quality improvements through reduced nutrients and fine sediment input, could be achieved through the addition of stockproof fencing and riparian planting.
- A small weir on Unnamed Tributary of Mire Sike 6.12 (Appleby to Brough) was assessed as likely to be impassable by all fish species under normal flow conditions. Removal or mitigation of this weir has the potential to improve connectivity of habitats locally.
- Removal of redundant culvert on Eastfield Sike associated with the MOD tank turning area. The current Flood Risk Assessment is based on modelling that assumes the presence of this culvert and the acceptability of this mitigation, in terms of flood risk, will need to be fully assessed.
- Extensive poaching (sheep) was recorded along Eastfield Sike (Appleby to Brough). Improvements in riparian and instream habitat, as well as water quality improvements through reduced nutrients and fine sediment input, could be achieved through the addition of stockproof fencing and riparian planting.
- A 300m length of Mains Gill is within a culvert. There is potential to daylight this section by removing the pipe culvert reconnecting habitats locally. The value of this mitigation, in terms of fish, should be assessed noting that the existing A66 culvert presents a barrier to the upper reaches of Mains Gill and that this section is ephemeral.

B1.21.52 Improvements to the riparian habitat of watercourses have also been included throughout the Project as part of BNG habitat creation and are included under wet woodland, species-rich grassland and or marsh/wet

grassland creation. These riparian habitat improvements will be beneficial to aquatic species.

Terrestrial Invertebrates

Habitat Creation

- B1.21.53 The results of the terrestrial invertebrate surveys provided in ES Appendix 6.8: Terrestrial Invertebrates (Application Document 3.4) highlighted the requirement for the following measures to mitigate the effects reported in ES Chapter 6: Biodiversity (Application Document 3.2).
- B1.21.54 The Project Ecologist will review opportunities to enhance proposed and retained habitats for terrestrial invertebrates. The following features can also be sited within ecology mitigation areas and highway verges, where suitable, as enhancement measures for terrestrial invertebrates.
- Deadwood – translocation of existing standing deadwood, creation of new deadwood where possible by selective pollarding and inflicting minor damage to selected retained trees to allow entrance of invertebrates through knot holes, broken branches and removed bark or to encourage sap runs.
 - Open Mosaic Habitat and natural succession – creation of additional habitat (a minimum of 0.25ha area) in locations likely to be subject to regular disturbance and creation on sites of existing or proposed demolition to allow natural succession to progress rather than planting.
 - Arboreal – planting of appropriate tree species and understory / scrub species to create structure and shade while woodland matures, creation of graded woodland transition margins, creation of open glades and rides in planted woodland, linking existing areas of mature woodland and translocation of high value mature trees.
 - Wetland – improve quality of existing wetland by creating areas of dryer and wetter habitat, use of ponds to create wetland habitat, inclusion of sphagnum / bog pools, scrapes or other temporary ponds among appropriate habitat.
 - Grassland – creation of tussocky areas, bare ground, and use of a locally appropriate floristic seed mix, prioritisation of south facing slopes and addition of specialised features such as bee banks, deadwood and water areas.

B1.22 Ecological Monitoring

Post construction

Bats

- B1.22.1 The effectiveness of the embedded and essential mitigation for roosting, commuting and foraging bats, including project-wide habitat replacement, will be monitored for bat activity post-construction by undertaking the following surveys.

- Bat activity surveys of features of District importance or greater, in line with current best practice (Collins, 2016)¹⁸, to include surveys at the crossing points identified during the radiotracking studies (notably RTCP4 and RTCP5).
- Roost monitoring surveys of any replacement roosts created, to comply with EPSL conditions.
- Roost activity surveys for a minimum of three years post-construction for the maternity roosts at Eden View Cottages (Roost 11), Old Stone Barn (Roost 23), Streetside Farm (Roost 29) and Rokeby Grove (Roosts 30 to 32).

B1.22.2 Where bat numbers drop or roost abandonment is observed following construction, and cannot be attributed to external factors, retroactive action would be required to maintain activity at its pre-construction levels. Interventions may include but are not limited to: creating/increasing additional roosting provision, adjusting environmental conditions within the roosting provision, checking that suitable access/egress is maintained and creating new access/egress points as necessary, enhancing nearby roosting provision, enhancing or planting habitat adjacent to the roosting provision or promoting habitat links between known roosts. These actions should be recorded within the activities undertaken on the mitigation licence.

Badger

- B1.22.3 A monitoring programme will be developed by the Project Ecologist to record evidence of regular use of the artificial sett. Surveys will include the use of sticks placed in entrance holes, camera-trap and recording field signs.
- B1.22.4 Periodic checks should be made of new badger culvert tunnel entrances, especially in the first two years, to ensure they are not blocked by debris or vegetation (or deliberately blocked), and that the entrances do not become waterlogged. Maintenance works required will be carried out by the PC within years 1 to 5 or National Highways after 5 years.
- B1.22.5 A monitoring programme will be developed to record evidence of regular passage use by the Project Ecologist. Surveys will include the use camera-traps and/or clay mats at the entrance of the crossing points to record prints.
- B1.22.6 For badger protection to remain effective, it is essential that fencing is properly maintained. Regular checks should be made, especially during the first two years when badgers will be adjusting to new pathways and crossing points, to ensure that the fencing has not been vandalised or damaged to the extent that badgers can gain access to the carriageway. Where badger casualties are noticed in previously unaffected areas, a thorough check should be made of the fencing in the vicinity.

¹⁸ Collins, J. (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London.

Otter

- B1.22.7 Any holt closures/disturbance and use of artificial holt will follow monitoring requirements as set out in the EPSL.
- B1.22.8 A monitoring programme will be developed by the Project Ecologist to record evidence of regular passage use by otter in the new otter underpasses. Surveys will include the use camera-traps and/or clay mats at the entrance of the crossing points to record prints.
- B1.22.9 Periodic checks should be made of new otter culvert tunnel entrances and ledges, especially in the first two years, to ensure they are not blocked by debris or vegetation (or deliberately blocked), and that the entrances do not become waterlogged / ledges collapsed. Maintenance works required will be carried out by the PC within years 1 to 5 or National Highways after 5 years.

Red Squirrel

- B1.22.10 Temporary supplementary feeders will be required in selected red squirrel mitigation areas until new planting becomes established and natural food resources become available. Supplementary feeders will provide red squirrel with a consistent year-round food resource and will enable them to continue to use the habitat.
- B1.22.11 The requirement for supplementary feeders will be on a rolling 5-year review programme until planting has become established and if trees are producing food. Feeding hoppers will need to be disinfected regularly to ensure they do not become diseased. Supplementary feeding will cease when new planting is sufficiently established and considered to be providing a food resource.
- B1.22.12 Long-term population monitoring and a reactive landscape management programme are key to maintaining the optimal value and success of the red squirrel bridges in the future. The Project Ecologist will devise a suitable monitoring regime for the red squirrel crossings in consultation with National Highways and the working group. Due to the long-term nature of the proposed mitigation, monitoring is likely to be over a 30-year period.

Birds (breeding and wintering)

- B1.22.13 All bird mitigation plots will require annual condition inspection and ecological monitoring for usage by lapwing and golden plover (November to February) as part of an adaptive management process to ensure the areas remain attractive to waders by supporting a short sward length and surface water. Where monitoring indicates these areas are over-grown or do not support surface water then management must be implemented prior to the start of the breeding season (March).

Barn Owl

- B1.22.14 A monitoring programme will be developed by the Project Ecologist to record evidence of regular use of the barn owl crossing points and / or mortality numbers. This will include the following as a minimum. Once obstacle planting has reached at least 3m in height, it should be monitored on an annual basis for the following five years to ensure the

integrity of these features. Should any feature fail and not be capable of delivering its aim, interventions will be required.

Reptile

B1.22.15 A monitoring programme will be developed by the Project Ecologist and included within the Reptile Method Statement to be produced prior to site clearance and construction works commencing. This will detail monitoring of reptile populations for at least five-years post-construction within the receptor sites used for reptile translocations.

B1.23 References

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Appendix A: Technical Advice Notes

A1: Provenance and Biosecurity

All native species supplied are to be of the most local provenance available in commercial volumes. The majority of the Project lies within UK Provenance Zone 3, Native Seed Zone 302 as defined in the Forestry Commission Information Note FCIN082. The westernmost extent of the Project lies in Provenance Zone 3, Native Seed Zone 301. Provenance Zone 301 will be acceptable if it can be evidenced that materials from 302 are not readily available in the quantities required.

PC to ensure that all plant materials are free of any pests and diseases as advised on the plant health portal (Department for Environment, Food and Rural Affairs, 2022)¹⁹. Provenance certificates will be required for all plant material and seed. Natively grown planting material will always be kept separate from imported stock.

The PC must demonstrate that they have carried out biosecurity and plant health risk assessments.

A2: Tubes, Guards and Ties

All plants are to be protected using individual spirals, guards or shelters. Biodegradable tree guards are preferable. NH may have a preference for the type/brand of tree guard that should be used.

Tree and shrub species planted as transplants to have suitable shelters such as of 60cm high with an internal measurement across any part of its width of 144 - 200mm, supported by timber stake or cane approx. 90 cm high, minimum 30mm diameter and with 2 releasable ratchet ties.

The shelter shall be pushed a minimum of 25mm into the ground. The stake shall be of sufficient length to support the shelter firmly for five years and shall not protrude above the rim height of the shelter but shall extend at least 75mm above the top tie. Where the shelter is attached to the stake by two releasable ratchet ties, one tie shall be positioned at, or within, 75mm of ground level and the other shall be positioned within 100mm of the shelter top. The shelters shall be the same colour throughout the works.

All standard, multi-stem and feathered trees shall have spiral guards minimum 600mm high to resist rabbit damage. The spiral guards shall be the same colour throughout the works. The spiral guards shall be wound round the stem of the plant to be protected to the full height of the spiral guard. The Contractor shall ensure that the gaps are kept to a minimum when winding the spiral guards around branched stems.

Where tree shelters are used, pits for shrub and tree transplants located on sloping ground shall be backfilled so the top of the pit forms a horizontal surface sufficient to enable the entire base of the shelter to be in contact with the ground.

¹⁹ Department for Environment, Food and Rural Affairs (2022) Plant Health Portal

Plant protection specification to be standardised across the Project, disparity between individual planting plots throughout the Project will not be accepted (UK Government, 2020)²⁰

A3: Site Inspection reports

Unless stated otherwise in subsequent iterations of the LEMP, MCHW clauses 3002, 3014 and 3015 shall apply to set out minimum communication requirements between the PC and National Highways which are particular to the landscape works.

The LA will monitor the Project LEs during years 0-5. The key responsibilities are as follows:

- Inspect the ground conditions prior to planting / seeding;
- Monitor the weather and report on conditions that may affect operations on site (e.g. in particularly wet conditions the grass cutting regime may need to be increased);
- Make recommendations to National Highways Representative;
- Record deliveries of plants and materials to site;
- Inspect tree pits and plant materials prior to planting;
- Meet with the landscape contractor at regular intervals on site during the implementation and establishment period, including setting out;
- Inspect the site at regular intervals during implementation and establishment;
- Provide inspection and progress reports to National Highways;

The inspection reports will be necessary to facilitate the handover of responsibilities at the end of the five-year period. National Highway's appointed contractor is encouraged to comment on the above responsibilities and activities and recommend any supplementary information they may require at handover.

A4: Series 3000 Drawings

Suggested drawing series.

- 3001 – Soil Stripping and Soil Storage
- 3002 – Soil Spreading
- 3003 – Planting and Seeding

Drawing requisites:

- Drawings to be 1:500 preferably and no greater than 1:1000 (@ A1).
- Drawings to show the following elements of the engineering design: hard landscaping, visibility splays, kerbs, slopes, swales, headwalls, and pipes.
- Drawings to show ecological features.
- Drawings to show fencing and gates.
- Drawings to show extent of works and cut lines for adjacent sheets.
- Key plan to be provided for multiple sheet sets.
- Adequate notes on drawings, narrative to support submissions, font size to be legible when drawings are printed at A3.

²⁰ UK Government (2020) Tree protection: The use of tree shelters and guards

- All planting beds to be clearly labelled with a unique bed number and bed size in square metres.

A5: Series 3000 Plant Schedules

At Tender and Construction stage the full planting Schedules should be provided as an excel spreadsheet to avoid having too much information on the drawings and to allow total quantities to be easily calculated and assist the tendering process. This will also assist with any contract growing.

A6: Series 3000 Specification appendices

To assist the checking process and for the benefit of the National Highways Representative, the landscape designer will need to set out at the beginning of each chapter of their Series 3000 specification appendices:

- The standard clauses which apply;
- The standard clauses which are excluded;
- Any standard clauses that have been clarified; and
- Any additional clauses.
- Re-numbering of the MCHW clauses will not be accepted in the Appendices.

Best practice example:

Appendix 30/6: Planting

Clause applies	1; 2; 4; 5; 8; 9; 10; 11; 18; 21; 34; 39; 40; 47; 48; 51; 56; 57; 86; 88; 89; 90
Clause excluded	19; 20; 23; 24; 25; 27; 28; 29; 30; 31; 32; 33; 42 to 45; 50; 58 to 64; 68 to 79; 80 to 85
Clause clarification (see below)	3; 5; 6; 7; 12; 13; 14; 15; 16; 17; 22; 26; 35; 36; 37; 38; 41; 46; 49; 52; 53; 54; 55; 65 to 67; 87; 91; 92

A7: Terminology

Drawings and specifications should avoid the following terms:

- As required;
- As necessary; and
- Or similar approved - instead use the term 'or acceptable equivalent'.

A8: Ground preparation

Refer to MCHW Volume 1 Clause 3004 and MCHW Volume 2 Clause NG 3004 for specification.

Appropriate ground preparation to achieve the required environmental functions involves close collaboration with the design team before it is too late to make the necessary modifications to the earthworks designs, soil strip and soil storage.

The PCs will ensure landscape specifications and designs are produced in conjunction with the Project Soil Handling and Management Strategy which shall include details of the excavation, deposition, depths and methods of soil placement and cultivation. The PCs must demonstrate in their design intent statements that

they have liaised with the engineer in this regard and any engineering constraints that compete with the required environmental functions will be clearly stated.

The PCs will ensure that the Series 600 (Earthworks) and Series 3000 are cross referenced to ensure that there are no conflicts relating to stripping, storage deposition and quality of soils. Soil provenance records will be required prior to placing of any soils. This is to ensure potential seedbanks within the soil complement the landscape objectives at the deposition site.

The guiding principle for creating species-rich road verges is to avoid the use of fertile topsoil. High soil fertility encourages excessive growth of non-desirable species and reduces the success of wildflower establishment. Newly created grassland must instead be finished with clean subsoil, bare mineral substrate or a maximum 15mm depth of topsoil.

In all areas to be planted the recommendation is site won topsoil or imported General Purpose grade topsoil to a minimum depth of 300mm after settlement laid over naturally occurring subsoil or 400mm of placed subsoil after settlement.

For areas where trees larger than 8cm in girth will be planted, BS 8545: 2014 shall apply to the planting depth and topsoil/subsoil horizon.

Use of saved topsoil: the only occasion where topsoil will be used to finish areas for wild flowers is where it can be saved from existing species-rich areas that will be destroyed as part of the development. This topsoil will contain a valuable seed bank of wild flowers and grasses and must be stored separately from other topsoil prior to re-use. Topsoil will be stored such that as much of the soil fauna survives when it moves to its new location.

The general principle shall be to retain as much vegetation as possible without adversely affecting the stated function of the LE. At the finer grain of design, consideration should be given to retaining patches of scrub or species rich grassland within larger areas to be seeded or planted as this will encourage natively occurring fauna and flora to colonise new habitats.

Regarding subsoil treatment prior to planting or seeding, a clear line of communication will be required between the PCs design team including geotechnical engineer and landscape contractor to establish extent and timing of any ripping of soils. Planting designs shall be well developed to the appropriate level of detail (e.g. plans at 1:1000 scale) prior to ground preparation operations commencing so that areas to receive planting and to be ripped are identified at the appropriate time and to minimise trafficking and compaction over placed topsoil.

Appendix B: Typical Maintenance Operations

The PC shall prepare a detailed management proposal detailing the construction phase for each scheme within the Project as required under the DCO that will be reviewed on an annual basis.

Whilst the nature of the maintenance operations set out will typically be repeated year on year, the frequency of such operations should be considered to be flexible in order that response can be made to any change in circumstances necessary to achieve the target outcomes. The maintenance schedule will therefore need to be reviewed on an annual basis to determine the exact requirements to suit the longer term management objectives.

Typical landscape maintenance operations for establishment and maintenance periods are listed out below in Table 9: Typical Maintenance Operations. This table will need to be revised in subsequent iterations of the LEMP to include detailed timing of ecological management prescriptions that fall under the responsibility of National Highways. This table will need to be revised in subsequent iterations of the LEMP to include detailed timing of ecology management and monitoring.

Table 9: Typical Maintenance Operations

Existing vegetation - Establishment Period Years 0-5													Maintenance Period Years 5+													
Activity	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D		
Tree inspections																										
Rubbish collection, lift and remove to authorised site																										
Replacement of any vegetation lost as a direct result of works. Woodland, woodland edge and hedgerows to be replaced in the dormant season between November and March or replaced with container grown stock and written approved watering plan in place																										
Monitoring invasive species, recording location and reporting to the Client																										
Existing grass cutting																										
Species Rich Grassland LE 1.3 / Marsh and Wet Grassland LE 6.4 - Establishment Period Years 0-5													Maintenance Period Years 5+													
Activity	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D		
Establishment cuts, collection of arisings and disposal off-site (two per year)																										
Post-establishment cut, collection of arisings and disposal off-site (one per year)*																										
*note for species-rich grassland with the EFB function, highways maintenance may require more regular cuts. For species-rich grassland with EFD function Years 3+ management may include grazing instead or, or in addition to, annual cutting.																										
Woodland LE 2.1 / Woodland Edge LE 2.2 / Scrub Planting LE 2.8 / Individual Trees LE 2.4 - Establishment Period Years 0-5													Maintenance Period Years 5+													
Activity	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D		
Plant and Tree Shelters	Check / secure / adjust tree stakes and fastenings																									
	Re-firm planted trees and stakes by treading around the base																									
Plant Inspections / Replacements	Plant inspections to determine plant failures e.g. - dead, diseased and dying tree stock																									
	Plant replacements as identified. Priority shall be given to completing replacement planting before the end of December each year if instructed.																									
Arboricultural works	Pruning including the removal of minor dead wood or damaged wood. Formative pruning shall be undertaken at the appropriate time of the year for the species involved in order to enhance the plants best feature																									
	Thinning and felling of woodland																									
Control of grass and weeds within areas of tree planting	Maintain clear vegetation strip around base of plants.																									
	Coarse grasses within open spaces near to plants are cut at minimal frequency with arisings collected and removed off site.																									
Native Species Hedgerows LE 4.3 / Native Hedgerows with Tress LE 4.4 - Establishment Period Years 0-5													Maintenance Period Years 5+ years													
Activity	Description	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	
Plant and Tree Shelters	All hedges to be inspected annually with hedges kept weed free during establishment. No more than 10% of the hedgerow length should be occupied by gaps																									
	Re-firm planted trees and stakes by treading around the base																									
	On each inspection of all above following storm events																									
Plant Inspections / Replacements	Plant inspections to determine plant failures e.g. - dead, diseased and dying tree stock																									
	Plant replacements as identified. Priority shall be given to completing replacement planting before the end of December each year if instructed.																									
Control of grass and weeds within areas of tree planting	Maintain clear vegetation strip around base of plants.																									
Cutting Hedgerows	New hedgerow planting shall not be cut during Years 1 to 3 inclusive. Pre-existing hedgerows (and planted hedgerows from Yr 4 onwards) to be cut every two years using a side-arm mounted flail during dormant period from November to February.																									
Cutting Hedges	Adjacent lengths of hedge shall be cut in different years. Hedgerow trees shall not be cut. Where appropriate short sections of hedgerow should be left untrimmed to promote diversity.																									

Appendix C: Relevant Standards and Guidance

The following is a list of advice publications, British Standards or “best practice” guidance notes deemed applicable to the undertaking of landscape works to which reference is required. This list is for guidance only, which the Site Operator may wish to update as required.

- LD 117 Landscape Design
- Managing grassland road verges: a best practice guide (Plantlife, 2019)
- National Highways. 'The Road to Good Design', 2018
- Landscape Institute, Infrastructure Technical Note 04/20, 2020
- Nick Robinson, The Planting Design Handbook, 2016
- GG101 Introduction to the Design Manual for Roads and Bridges
- GG 103 Introduction and general requirements for sustainable development.
- LD 119 Roadside environmental mitigation and enhancement
- LA 104, 'Environmental assessment and monitoring'
- LA 120 Environmental Management Plans
- British Standards (Published by British Standards Institution):
- BS 1722 Specification for fences (all parts)
- BS 3882: 2015 Specification for Topsoil
- BS 3936 Part1:1992 Nursery stock (all parts)
- BS 3998:2010 Tree Work - Recommendations
- BS 4428:1989 Code of practice for general landscape operations (excluding hard surfaces)
- BS 4043:1989 Transplanting root-balled trees
- BS 5837:2012 Trees in relation to design, demolition and construction. Recommendations
- BS 7370 Grounds maintenance (all parts)
- BS 8545: 2014 Trees: from nursery to independence in the landscape – Recommendations
- BS 8601:2013 Specification for subsoil and requirements for use
- Arboricultural Association
- D. Lonsdale 1983: A Definition of the Best Pruning Position; Arboricultural Research Note 48/83
- D. Lonsdale 1993: Choosing the Time of Year to Prune Trees; Arboricultural Research Note 117/93
- Stakes and Ties (1989); Arboricultural Research Note 77/89
- Guidance Note 3: Planting and Managing Amenity Woodlands
- HMSO / DEFRA
- The Body Language of Trees: A Handbook for Failure Analysis, published by the Department of the Environment, Transport and the Regions
- Weeds Act 1959
- Wildlife and Countryside Act, 1981, as amended
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002, as amended
- The Control of Pesticides Regulations 1986 (COPR), as amended by the Control of Pesticides (Amendment) Regulations 1997
- Regulation EC 396/2005 amending EC Directive 91/414/EEC
- The Plant Protection Products Regulations 2011 (as amended)

- The Water Supply (Water Quality) Regulations 2010
- The Control of Pollution Act 1974 & 1989 Amendments
- Identification of Injurious Weeds (2011 DEFRA); MAFF - Leaflet to support Weeds Act 1959
- Guidelines for the use of herbicides on weeds in or near watercourses and lakes (1996); MAFF
- Pesticide - Code of Practice for Using Plant Protection Product (2012); HSE
- Horticultural Trades Association and the Joint Council for Landscape Industries
- National Plant Specification (1985), published by the Committee for Plant Supply and Establishment and the HTA
- The Cranfield National soil map

Appendix D: Figures